

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 06-210175
(43)Date of publication of application : 02.08.1994

(51)Int.Cl.

B01J 23/89
B01D 53/36
B01D 53/36

(21)Application number : 05-026068
(22)Date of filing : 20.01.1993

(71)Applicant : DAIHATSU MOTOR CO LTD
(72)Inventor : FUJIKAWA HIROTOSHI
TANAKA HIROHISA
TAKAHASHI ICHIRO

(54) CATALYST FOR PURIFICATION OF EXHAUST GAS AND ITS PRODUCTION

(57)Abstract:

PURPOSE: To provide a catalyst having satisfactory purification activity even in the condition of a low temp. of exhaust gas and excellent in durability, as well.

CONSTITUTION: The objective catalyst has palladium allowed to coexist with a mixture of a perovskite type multiple oxide with a heat resistant oxide so that palladium is present at a higher concn. on the perovskite type multiple oxide than that on the heat resistant oxide. When the catalyst is produced, an aq. palladium salt soln. of \leq pH4 or $>$ pH10 is carried on the above- perovskite type multiple oxide by impregnation or adsorption, the oxide is dried, calcined and dispersed in water together with the heat resistant oxide and the resulting slurry is dried and fired.

LEGAL STATUS

[Date of request for examination] 28.05.1998
[Date of sending the examiner's decision of rejection]
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]
[Date of final disposal for application]
[Patent number] 3229054
[Date of registration] 07.09.2001
[Number of appeal against examiner's decision of rejection]
[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

JAPANESE

[JP,06-210175,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS
EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

* NOTICES *

JPO and NCIP are not responsible for any
damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.

3. In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] It is the catalyst for emission gas purification characterized by for noble metals living together into the mixture of the perovskite mold multiple oxide and the heat-resistant oxide which are shown by general formula $Ln_{1-x}AxMO_3$ (the rare earth metal except Ce and A are transition metals, and Ln is [alkaline earth metal, or Ce and M] all one sort or two sorts or more, and $0 < x < 1$), and said noble metals existing on said perovskite mold multiple oxide rather than said heat-resistant oxide top at high concentration.

[Claim 2] Said perovskite mold multiple oxide is a catalyst for emission gas purification according to claim 1 which has structure where the perovskite mold multiple oxide which dissolved noble metals was formed in the perimeter, by using as a nucleus the perovskite mold multiple oxide which does not contain noble metals.

[Claim 3] The catalyst for emission gas purification according to claim 1 or 2 which the oxide of noble metals or noble metals is distributing in the state of a particle.

[Claim 4] Noble metals are catalysts for emission gas purification according to claim 1, 2, or 3 which are one sort or two sorts or more of metals chosen from the group which consists of Pd, Pt, Ru, Rh, and Ir.

[Claim 5] Noble metals are catalysts for emission gas purification according to claim 4 which are Pd.

[Claim 6] General formula $Ln_{1-x}AxMO_3$ (the rare earth metal excluding [Ln] Ce, an alkaline earth metal excluding [A] Sr, or Ce and M are transition metals) All to one sort or two sorts or more, and the perovskite mold multiple oxide shown by $0 < x < 1$ The manufacture approach of the catalyst for emission gas purification characterized by drying and calcinating after it makes the noble-metals salt water solution prepared by four or less support by sinking in or adsorption, pH distributes water with a heat-resistant oxide desiccation and after carrying out temporary quenching, and it considers as a slurry.

[Claim 7] General formula $Ln_{1-x}AxMO_3$ (alkaline earth metal, or Ce and M of the rare earth metal excluding [Ln] Ce and A are transition metals) All to one sort or two sorts or more, and the perovskite mold multiple oxide shown by $0 < x < 1$ The manufacture approach of the catalyst for emission gas purification characterized by drying and calcinating after making the noble-metals salt water solution prepared so that pH might become larger than 10 support by sinking in or adsorption, distributing water with a heat-resistant oxide desiccation and after carrying out temporary quenching, and considering as a slurry.

[Translation done.]

* NOTICES *

JPO and NCIP are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.

2. **** shows the word which can not be translated.

3. In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the catalyst for emission gas purification which shows purification activity also on the conditions that the exhaust gas temperature at the time of an idling etc. is low, and its manufacture approach in the catalyst for exhaust gas purification excellent in the purification capacity of a carbon monoxide (CO), a hydrocarbon (HC), and nitrogen oxide (NOx), especially the gasoline engine for automobiles, etc.

[0002]

[Description of the Prior Art] As a three way component catalyst for exhaust gas purification, the precious metal catalyst which supported noble metals, such as Pt, Rh, and Pd, is put in practical use by alumina support, and it is widely used for it. Moreover, utilization is expected as a cheap three way component catalyst for exhaust gas purification with which the multiple oxide which has the perovskite type structure which consists of a rare earth metal, an alkaline earth metal, and transition metals purifies CO, HC, and NOx (refer to JP,59-87046,A and JP,60-82138,A). Although CO and the purification capacity of HC are excellent, this perovskite mold multiple oxide is a little inferior in the purification capacity of NOx, and they are not enough to present practical use as a three way component catalyst for automobile exhaust. Then, in order to heighten the NOx purification capacity of a perovskite mold multiple oxide catalyst, also making noble metals live together is proposed (refer to JP,1-168343,A).

[0003]

[Problem(s) to be Solved by the Invention] Although these catalysts show the purification activity excellent in the conditions that exhaust gas temperature like [at the time of transit of an automobile] is high, they do not show purification activity sufficient on the conditions that the exhaust gas temperature at the time of an idling etc. is low. A catalyst which shows sufficient purification activity also on the conditions that such exhaust gas temperature is low, with exhaust gas toughening of regulations is desired. In order to raise the thermal resistance of a perovskite mold multiple oxide catalyst, it can consider making a heat-resistant oxide live together. When it is going to make palladium live together as noble metals into the mixture of a perovskite mold multiple oxide and heat-resistant oxide, after infiltrating a palladium salt water solution into the mixture of oxide, it is possible to calcinate. When the specific surface area of a perovskite mold multiple oxide uses for example, the Seria system multiple oxide as a heat-resistant oxide to 5-50m²/g and a large thing being 100m²/g, the specific surface area is large like 100-250m²/g. When a palladium salt water solution is infiltrated into the mixture of an oxide, the fine particles of each oxide are adsorbed in palladium with the surface coverage mostly proportional to specific surface area. That is, as for a heat-resistant oxide top, the noble metals for heightening NOx purification capacity are adsorbed by high concentration rather than a perovskite mold multiple oxide top.

[0004] In order to raise the property of both low-temperature activity and endurance, as for noble metals, such as palladium, it is desirable for high concentration to be adsorbed by the perovskite mold multiple oxide top. This invention aims at offering the manufacture approach for the catalyst for emission gas purification excellent also in endurance while it shows purification activity sufficient also on the conditions that exhaust gas temperature is low.

[0005]

[Means for Solving the Problem] With the catalyst for emission gas purification of this invention, noble metals live together into the mixture of the perovskite mold multiple oxide and the heat-resistant oxide which are shown by general formula $Ln_{1-x}AxMo_3$ (the rare earth metal except Ce and A are transition metals, and Ln is [alkaline earth metal, or Ce and M] all one sort or two sorts or more, and $0 < x < 1$), and said noble metals exist on said perovskite mold multiple oxide rather than said heat-resistant oxide top at high concentration. In the desirable mode, the perovskite mold multiple oxide is having structure where the perovskite mold multiple oxide which dissolved noble metals was formed in the perimeter, by using as a nucleus the perovskite mold multiple oxide which does not contain noble metals. When noble metals exist superfluously, the noble metals which were not able to dissolve are distributed in the state of a particle as a metal or an oxide. Noble metals are one sort or two sorts or more of metals chosen from the group which consists of Pd, Pt, Ru, Rh, and Ir, and especially Pd raises low-temperature purification activity and NOx purification activity, and is desirable.

[0006] Especially the class of heat-resistant oxide has the desirable multiple oxide which is not what is restricted and which is expressed with the general formulas $(CeZrLn)O_2$ (rare earth metal excluding [Ln] Ce), such as $O(CeZrY)_2$, $O(CeZrLa)_2$, $O(CeZrNd)_2$, etc. besides CeO_2 and $O(CeZr)_2$. Moreover, since two are excelled in the effectiveness that the direction of $CeOO(CeZr)_2$ raises hot purification activity and it excels in the effectiveness that the direction of O_2 raises hot purification activity further $(CeZrLn)$, it is more desirable. Moreover, the thing (refer to JP,62-56322,A) containing at least one kind of metallic oxide chosen from the group which makes the second cerium of oxidation a subject, for example, and becomes it from aluminum, Si, Zr, Th, and a rare earth metal element may be used.

[0007] In one mode of the manufacture approach of this invention, it is general formula $Ln_{1-x}AxMo_3$ (the rare earth metal excluding [Ln] Ce, an alkaline earth metal excluding [A] Sr, or Ce and M are transition metals). All are dried and calcinated after making it

support by sinking in or adsorption, making one sort or two sorts or more, and the perovskite mold multiple oxide in which it is shown by $0 < x < 1$ distribute in water the noble-metals salt water solution with which pH was prepared by four or less with a heat-resistant oxide desiccation and after carrying out temporary quenching, and considering as a slurry. When pH is prepared and manufactured or less to four, a perovskite mold multiple oxide turns into an oxide with which the perovskite mold multiple oxide which dissolved noble metals enclosed the surroundings of it by using a perovskite mold multiple oxide as a nucleus. In the case of the manufacture approach which makes pH of a noble-metals salt water solution four or less As a water-soluble noble-metals salt, chlorides, such as nitrates, such as PdCl₂, PtCl₂, and RuCl₃·3H₂O, Dinitro diamine salts of that a water solution indicates strong acid nature to be, such as nitrates, such as Pd(NO₃)₂, Ru (NO₃)₃, and Rh (NO₃)₃, Pd(NO₂)₂(NH₃)₂, and Pt(NO₂)₂(NH₃)₂, etc. are desirable.

[0008] In other modes of the manufacture approach of this invention, the perovskite mold multiple oxide shown by general formula Ln_{1-x}A_xMO₃ (A contains Sr in this case) is made to support the noble-metals salt water solution prepared so that pH might become larger than 10 by sinking in or adsorption, and it dries and calcinates, after distributing water and considering as a slurry with the thermal-resistance oxide desiccation and after carrying out temporary quenching. In the case of the manufacture approach which makes pH of a noble-metals salt water solution larger than 10 Tetrapod amine palladium dichloride Pd(NH₃)₄Cl₂ and tetra-amine palladium oxalate (NH₃)₄(OH) Pd 4 [whether it prepares and uses so that aqueous ammonia and an acid may be added in basic water solutions, such as 2, and it may be set to pH>10, and] Nitrates, such as chlorides, such as PdCl₂, PtCl₂, and RuCl₃·3H₂O, and Pd (NO₃)₂, Ru (NO₃)₃, Rh (NO₃)₃, Or it prepares and uses so that aqueous ammonia may be added to aqueous acids, such as dinitro diamine salts, such as Pd(NO₂)₂(NH₃)₂ and Pt(NO₂)₂(NH₃)₂, and it may be set to pH>10.

[0009]

[Effect of the Invention] The catalyst of this invention shows the purification activity which was excellent to HC, CO, and NO_x also in the low conditions whose exhaust gas temperature at the time of an idling etc. is about 100-200 degrees C. Moreover, while being able to use even an elevated temperature 900 degrees C or more including a heat-resistant oxide, it becomes a durable catalyst when noble metals effective in purification of NO_x exist on a perovskite mold multiple oxide rather than the heat-resistant oxide top at high concentration.

[0010]

[Example]

(Example 1)

Procedure A : The preparation approach of manufacture approach perovskite mold multiple oxide (La_{0.8}Ce_{0.2}) (Co_{0.4}Fe_{0.6}) O₃ powder of perovskite mold multiple oxide crystal powder is explained. 103.9g of lanthanum nitrates, 26.1g of cerium nitrates, 34.9g of cobalt nitrates, and 0.3L of water solutions which dissolved 72.7g of iron nitrate in pure water were prepared. Next, 0.5L of water solutions which dissolved 50g of sodium carbonates as a neutralization coprecipitator was prepared. The neutralization coprecipitator was dropped at the previous water solution, and the coprecipitate was obtained. The vacuum drying was carried out, after rinsing the coprecipitate enough and filtering it. This was ground after baking in 3-hour atmospheric air at 600 degrees C, and it calcinates in 3-hour atmospheric air at 800 degrees C after that, and ground further, and the powder of O(Co(La_{0.8}Ce_{0.2})_{0.4}Fe_{0.6})₃ was produced.

[0011] cerium oxide powder of a commercial high specific surface area [oxide / which is used as a manufacture co-catalyst of a procedure B thermal-resistance oxide / heat-resistant] : (CeO₂ specific-surface-area 170m²/g →) 99.9% of purity and TREO(all rare earth oxides)111.9g are prepared. To this, 147.9g (contained 25.0% of the weight by ZrO₂ conversion in liquid density 1.51 and liquid) of oxy-zirconium-nitrate (ZrO₂ (NO₃)₃) water solutions, And 26.0g (contained 21.7% of the weight by 2OY₃ conversion in liquid density 1.62 and liquid) of nitric-acid yttrium (Y(NO₃)₃) water solutions was added, and it dried in 10-hour atmospheric air at 110 degrees C, having agitated well and mixing. Then, baking was performed at 600 degrees C in atmospheric air for 3 hours, and about 150g of O(Ce_{0.65}Zr_{0.30}Y_{0.05})₂ multiple oxides was obtained.

[0012]

Procedure C : The palladium nitrate solution (Pd concentration 4.4wt%) 25 weight section and the pure-water 50 weight section were mixed so that it might become the 1.1 weight section by part for the content Pd of Pd to perovskite powder, and pH of liquid was prepared to 1.8. After adding the pure-water 20 weight section to the O(Co(La_{0.8}Ce_{0.2})_{0.4}Fe_{0.6})₃ perovskite mold multiple oxide powder 98.9 weight section manufactured in Procedure A and agitating enough, the above-mentioned Pd salt water solution 75 weight section adjusted to pH1.8 was infiltrated, and it agitated enough, and held for 30 minutes at 40 degrees C. Then, after drying at 120 degrees C for 12 hours and calcinating at 600 degrees C in air for 3 hours, continuing churning, the agate mortar ground and a 180-micrometer mesh was passed. Pd added to the perovskite powder 98.9 weight section is equivalent to the 1.1 weight section by part for a metal.

[0013] Procedure D : Slurry coat (support)

The heat-resistant oxide powder which manufactured Pd content perovskite powder obtained in Procedure A in 50 weight sections and Procedure B 50-weight sections, A ceria sol (solid content 10wt%) 50 weight sections (solid content 5 weight sections), And it mixed, while the 58.7 weight sections were added and the ball mill ground pure water for 12 hours so that total solids might become 50wt(s)% about a zirconia sol (solid content 30wt%) at the 3.3 weight sections (solid content 1 weight section), and the slurry was obtained. After making the slurry flow into a KOZE light honeycomb, the excessive slurry was blown off by airstream and homogeneity was coated. The honeycomb behind a slurry coat was dried at 120 degrees C for 12 hours, in air, it calcinates at 600 degrees C for 3 hours, and the honeycomb-like sample was obtained.

[0014] Procedure E : The same palladium nitrate solution (Pd concentration 4.4wt%) 12.5 weight section as what was used for the re-addition pan of Pd in Procedure C was mixed with the pure-water 50 weight section, and pH of liquid was prepared to 1.8. After having immersed the honeycomb-like sample in this solution whole quantity, holding at 40 degrees C for 2 hours, making Pd adsorb and making it dry at 120 degrees C for 12 hours, in air, it calcinates at 600 degrees C for 3 hours, and the catalyst sample of an example 1 was obtained.

[0015] The analysis result by EPMA (electron probe microanalyzer) of this catalyst sample is shown in the photograph of drawing 1. With a photograph, an image is an image by the scanning electron microscope (SEM), a big black particle is a perovskite mold multiple

oxide, and magnitude is about 10 micrometers. A small white particle is a heat-resistant oxide particle, and magnitude is about 3 micrometers. Rhine which crosses a center in a longitudinal direction is criteria Rhine which shows the location which performed line analysis, and the wave expresses Pd concentration on the analytical line. According to the result of this photograph, Pd concentration of the periphery section of a perovskite mold multiple oxide particle is high [else].

[0016] (Example 2) The palladium nitrate solution used in the procedure E of an example 1 was changed into the tetra-ammine palladium nitrate (Pd concentration 4.6wt%), and the catalyst sample of an example 2 was obtained by actuation like the example 1 except having added the aqueous ammonia 50 weight section and having set pH to 13.0.

[0017] (Example 3) The powder which added the amount which the palladium nitrate solution used in the procedure C of an example 1 was changed into the tetra-ammine palladium nitrate (Pd concentration 4.6wt%), and also is equivalent to the 1.1 weight section in Pd to the perovskite mold multiple oxide powder 98.9 weight section by the same actuation as procedure A-C of an example 1 with a part for a metal was obtained. Then, the catalyst sample of an example 3 was obtained by the same actuation as an example 1.

[0018] (Example 4) Both changing into the tetra-ammine palladium nitrate (Pd concentration 4.6wt%) the palladium nitrate solution used in the palladium nitrate solution and Procedure E which were used in the procedure C of an example 1, others obtained the catalyst sample of an example 4 like the example 1.

[0019] (Example 5) In the procedure C of an example 1, 50 weight sections were measured so that it might become the 2.2 weight sections by part for Pd about a palladium nitrate solution, and the catalyst sample of an example 5 was obtained by the same actuation as an example 1 except having skipped Procedure E.

[0020] (Example 6) In the procedure C of an example 1, the palladium nitrate solution was replaced with the tetra-ammine palladium nitrate (Pd concentration 4.6wt%), the 47.8 weight sections were measured so that it might become the 2.2 weight sections by part for Pd, and the aqueous ammonia 50 weight section was added, it was referred to as pH=13.0, and the catalyst sample of an example 6 was obtained by the same actuation as an example 1 except having skipped Procedure E.

[0021] (Example 7) Replacing with O₃(Co(La0.8Sr0.2)0.4Fe0.6) powder perovskite mold multiple oxide (La0.8Ce0.2) (Co0.4Fe0.6) O₃ powder used in the example 4, others obtained the catalyst sample of an example 7 by the same actuation as an example 4.

[0022] (Example 8) Replacing with O₃(Co(La0.8Sr0.2)0.4Fe0.6) powder perovskite mold multiple oxide (La0.8Ce0.2) (Co0.4Fe0.6) O₃ powder used in the example 6, others obtained the catalyst sample of an example 8 by the same actuation as an example 6.

[0023] (Example 9) Replacing with La0.8Ce0.2CoO₃ powder perovskite mold multiple oxide (La0.8Ce0.2) (Co0.4Fe0.6) O₃ powder used in the example 5, others obtained the catalyst sample of an example 9 by the same actuation as an example 5.

[0024] (Example of a comparison) 20Pt-Rh/aluminum3 catalyst which is a catalyst for automobiles already put in practical use was made into the catalyst sample of the example of a comparison. The Pt-Rh content was the 0.43 weight section. The presentation of an example and the example of a comparison is shown in Table 1, and the measurement result of each catalytic activity is shown in Table 2.

[0025]

[Table 1]

	ペロブスカイト型複合酸化物	Pd含有量 (手順C)	溶液PH (手順C)	耐熱性酸化物	溶液PH (手順E)	総Pd量	
実施例 1	(La _{0.8} Ce _{0.2})(Co _{0.4} Fe _{0.6})O ₃ [50]	[0.55]	1.8	(Ce _{0.65} Zr _{0.30} Y _{0.05})O ₂ [50]	1.8	Pd[1.1]	
実施例 2	(La _{0.8} Ce _{0.2})(Co _{0.4} Fe _{0.6})O ₃ [50]	[0.55]	1.8	(Ce _{0.65} Zr _{0.30} Y _{0.05})O ₂ [50]	13.0	Pd[1.1]	
実施例 3	(La _{0.8} Ce _{0.2})(Co _{0.4} Fe _{0.6})O ₃ [50]	[0.55]	13.0	(Ce _{0.65} Zr _{0.30} Y _{0.05})O ₂ [50]	1.8	Pd[1.1]	
実施例 4	(La _{0.8} Ce _{0.2})(Co _{0.4} Fe _{0.6})O ₃ [50]	[0.55]	13.0	(Ce _{0.65} Zr _{0.30} Y _{0.05})O ₂ [50]	13.0	Pd[1.1]	
実施例 5	(La _{0.8} Ce _{0.2})(Co _{0.4} Fe _{0.6})O ₃ [50]	[1.1]	1.8	(Ce _{0.65} Zr _{0.30} Y _{0.05})O ₂ [50]	—	Pd[1.1]	
実施例 6	(La _{0.8} Ce _{0.2})(Co _{0.4} Fe _{0.6})O ₃ [50]	[1.1]	13.0	(Ce _{0.65} Zr _{0.30} Y _{0.05})O ₂ [50]	—	Pd[1.1]	
実施例 7	(La _{0.8} Si _{0.2})(Co _{0.4} Fe _{0.6})O ₃ [50]	[0.55]	13.0	(Ce _{0.65} Zr _{0.30} Y _{0.05})O ₂ [50]	13.0	Pd[1.1]	
実施例 8	(La _{0.8} Si _{0.2})(Co _{0.4} Fe _{0.6})O ₃ [50]	[1.1]	13.0	(Ce _{0.65} Zr _{0.30} Y _{0.05})O ₂ [50]	—	Pd[1.1]	
実施例 9	(La _{0.8} Ce _{0.2})CeO ₃	[50]	[1.1]	1.8	(Ce _{0.65} Zr _{0.30} Y _{0.05})O ₂ [50]	—	Pd[1.1]
比較例				γ-Al ₂ O ₃	[100]	1.8	Pt-Rh[0.43]

[]内の数値は重量部を表わす。

	初期 50% 清化温度 (°C)			耐久後 50% 清化温度 (°C)		
	CO	HC	NO	CO	HC	NO
実施例 1	138	156	155	231	236	220
実施例 2	131	151	151	220	226	218
実施例 3	150	167	169	232	237	223
実施例 4	141	164	170	226	233	218
実施例 5	138	162	152	212	224	214
実施例 6	132	166	168	231	240	216
実施例 7	134	155	148	218	231	225
実施例 8	130	160	155	227	241	234
実施例 9	129	154	137	236	246	248
比較例	193	208	198	263	276	259

[0027] Measurement and the durability test of catalytic activity were performed as follows.

Activity was measured for each sample supported by the measurement honeycomb-like (number of cells 400-/inch²) cordierite support (the diameter of 30mm, die length of 50mm) of catalytic activity by the following model gas. The inlet gas temperature to a catalyst shows gas temperature, it carries out a temperature up from a room temperature, and makes purification temperature to which each of NO, CO, and HC (C₃H₆+C₃H₈) fell to 50% of initial concentration 50%. Moreover, rich gas and lean gas were switched for every second, respectively. Space velocity (SV) of the gas stream which passes along a catalyst was made into 30,000-/time amount.

[0028]

Rich gas Lean gas CO 2.6 % 0.7 % HC (C₁ conversion concentration) 0.19% 0.19% H₂ 0.87% 0.23% CO₂ 8 % 8 % NO 0.17% 0.17% O₂ 0.65% 1.8 % H₂O 10% 10 % N₂ Remainder Remainder [0029] The rich gas and lean gas of the durability test above were switched every 5 seconds, it repeated at 900 degrees C for 30 minutes, the cycle of 30 minutes was repeated 15 times at 750 degrees C, and the durability test was performed. Catalytic activity was measured by the aforementioned approach also after the durability test. 50% purification temperature is low after durability, and high in the example of a comparison to it so that clearly from the result of Table 2. [in / at each example / the first stage]

[Translation done.]

*NOTICES *

JPO and NCIP are not responsible for any
damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.

3. In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the microphotography in which a metal presentation and palladium distribution of the catalyst of an example are shown.

[Translation done.]

(19)日本国特許庁 (JP)

(12) 公開特許公報 (A)

(11)特許出願公開番号

特開平6-210175

(43)公開日 平成6年(1994)8月2日

(51)Int.Cl⁵

識別記号 庁内整理番号

F I

技術表示箇所

B 01 J 23/89

ZAB A 8017-4G

B 01 D 53/36

ZAB 9042-4D

104 A 9042-4D

審査請求 未請求 請求項の数7 FD (全7頁)

(21)出願番号

特願平5-26068

(22)出願日

平成5年(1993)1月20日

(71)出願人 000002967

ダイハツ工業株式会社

大阪府池田市ダイハツ町1番1号

(72)発明者 藤川 寛敏

滋賀県蒲生郡竜王町大字山之上3000番地

ダイハツ工業株式会社滋賀テクニカルセンター内

(72)発明者 田中 裕久

滋賀県蒲生郡竜王町大字山之上3000番地

ダイハツ工業株式会社滋賀テクニカルセンター内

(74)代理人 弁理士 野口 繁雄

最終頁に続く

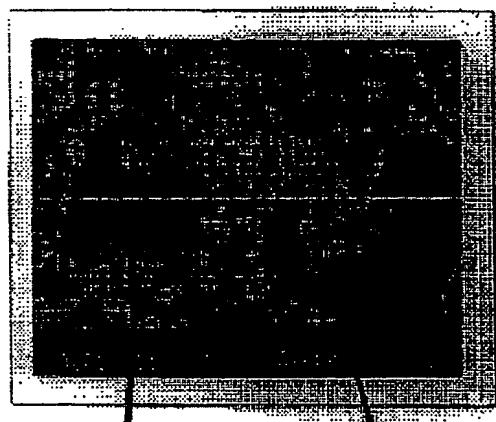
(54)【発明の名称】 排ガス浄化用触媒及びその製造方法

(57)【要約】

【目的】 排ガス温度が低い条件でも十分な浄化活性を示し、耐久性も優れたものとする。

【構成】 ベロブスカイト型複合酸化物と耐熱性酸化物との混合物にパラジウムが共存し、かつパラジウムは耐熱性酸化物上よりもベロブスカイト型複合酸化物上に高濃度に存在するようとする。その製造方法では、ベロブスカイト型複合酸化物に、pHが4以下又は10より大きく調製されたパラジウム塩水溶液を含浸又は吸着により担持させ、乾燥及び仮焼させた後、耐熱性酸化物とともに水に分散させてスラリーとした後、乾燥及び焼成する。

国際使用登録



写 真

BEST AVAILABLE COPY

1

【特許請求の範囲】

【請求項1】 一般式 $Ln_{1-x}A_xMO_3$ (Ln はCeを除く希土類金属、Aはアルカリ土類金属又はCe、Mは遷移金属で、いずれも1種又は2種以上、 $0 < x < 1$) で示されるペロブスカイト型複合酸化物と耐熱性酸化物との混合物に貴金属が共存し、かつ前記貴金属は前記耐熱性酸化物上よりも前記ペロブスカイト型複合酸化物上に高濃度に存在していることを特徴とする排ガス浄化用触媒。

【請求項2】 前記ペロブスカイト型複合酸化物は貴金属を含まないペロブスカイト型複合酸化物を核としてその周囲に貴金属を固溶したペロブスカイト型複合酸化物が形成された構造をしている請求項1に記載の排ガス浄化用触媒。

【請求項3】 貵金属又は貴金属の酸化物が微粒子状態で分散している請求項1又は2に記載の排ガス浄化用触媒。

【請求項4】 貵金属はPd、Pt、Ru、Rh及びIrからなる群より選ばれた1種又は2種以上の金属である請求項1、2又は3に記載の排ガス浄化用触媒。

【請求項5】 貵金属はPdである請求項4に記載の排ガス浄化用触媒。

【請求項6】 一般式 $Ln_{1-x}A_xMO_3$ (Ln はCeを除く希土類金属、AはSrを除くアルカリ土類金属又はCe、Mは遷移金属で、いずれも1種又は2種以上、 $0 < x < 1$) で示されるペロブスカイト型複合酸化物に、pHが4以下に調製された貴金属塩水溶液を含浸又は吸着により担持させ、乾燥及び仮焼させた後、耐熱性酸化物とともに水に分散させてスラリーとした後、乾燥及び焼成することを特徴とする排ガス浄化用触媒の製造方法。

【請求項7】 一般式 $Ln_{1-x}A_xMO_3$ (Ln はCeを除く希土類金属、Aはアルカリ土類金属又はCe、Mは遷移金属で、いずれも1種又は2種以上、 $0 < x < 1$) で示されるペロブスカイト型複合酸化物に、pHが10より大きくなるように調製された貴金属塩水溶液を含浸又は吸着により担持させ、乾燥及び仮焼させた後、耐熱性酸化物とともに水に分散させてスラリーとした後、乾燥及び焼成することを特徴とする排ガス浄化用触媒の製造方法。

【発明の詳細な説明】

【0001】

【産業上の利用分野】 本発明は一酸化炭素(CO)、炭化水素(HC)及び酸化窒素(NO_x)の浄化能力に優れた排ガス浄化用触媒、特に自動車用ガソリンエンジンなどにおいて、アイドリング時などの排ガス温度が低い条件でも浄化活性を示す排ガス浄化用触媒と、その製造方法に関するものである。

【0002】

【従来の技術】 排ガス浄化用三元触媒としてはアルミ

2

ナ担体にPt、Rh、Pdなどの貴金属を担持した貴金属触媒が実用化されて広く使用されている。また、希土類金属、アルカリ土類金属及び遷移金属から構成されるペロブスカイト型構造を有する複合酸化物は、CO、HC及びNO_xを浄化する安価な排気ガス浄化用三元触媒として実用化が期待されている(特開昭59-87046号公報、特開昭60-82138号公報参照)。このペロブスカイト型複合酸化物はCO、HCの浄化能力は優れているが、NO_xの浄化能力がやや劣っており、自動車排ガス用の三元触媒として実用に供するには十分でない。そこで、ペロブスカイト型複合酸化物触媒のNO_x浄化能力を高めるために、貴金属を共存させることも提案されている(特開平1-168343号公報参照)。

【0003】

【発明が解決しようとする課題】 これらの触媒は、自動車の走行時のような排ガス温度が高い条件では優れた浄化活性を示すが、アイドリング時などの排ガス温度が低い条件では十分な浄化活性を示さない。排ガス規制強化にともなってそのような排ガス温度が低い条件でも十分な浄化活性を示す触媒が望まれている。ペロブスカイト型複合酸化物触媒の耐熱性を高めるために、耐熱性酸化物を共存させることが考えられる。ペロブスカイト型複合酸化物と耐熱性酸化物との混合物に貴金属としてパラジウムを共存させようとした場合、酸化物の混合物にパラジウム塩水溶液を含浸させた後、焼成することが考えられる。ペロブスカイト型複合酸化物の比表面積は5~50m²/g、大きいものでも100m²/gであるのにに対し、耐熱性酸化物として例えばセリア系複合酸化物を用いるとその比表面積は100~250m²/gというよう大きい。パラジウム塩水溶液を酸化物の混合物に含浸させた場合、ほぼ比表面積に比例した吸着率でそれぞれの酸化物の粉体にパラジウムが吸着される。つまり、NO_x浄化能力を高めるための貴金属はペロブスカイト型複合酸化物上よりも耐熱性酸化物上により高濃度に吸着される。

【0004】 低温活性と耐久性の両方の特性を向上させるためには、パラジウムなどの貴金属はペロブスカイト型複合酸化物上により高濃度に吸着されることが望ましい。本発明は排ガス温度が低い条件でも十分な浄化活性を示すとともに、耐久性にも優れた排ガス浄化用触媒と、その製造方法を提供することを目的とするものである。

【0005】

【課題を解決するための手段】 本発明の排ガス浄化用触媒では、一般式 $Ln_{1-x}A_xMO_3$ (Ln はCeを除く希土類金属、Aはアルカリ土類金属又はCe、Mは遷移金属で、いずれも1種又は2種以上、 $0 < x < 1$) で示されるペロブスカイト型複合酸化物と耐熱性酸化物との混合物に貴金属が共存し、かつ前記貴金属は前記耐熱性酸

化物上よりも前記ペロブスカイト型複合酸化物上に高濃度に存在している。好ましい態様では、ペロブスカイト型複合酸化物は、貴金属を含まないペロブスカイト型複合酸化物を核としてその周囲に貴金属を固溶したペロブスカイト型複合酸化物が形成された構造をしている。貴金属が過剰に存在した場合、固溶しきれなかった貴金属は、金属又は酸化物として微粒子状態で分散する。貴金属はPd、Pt、Ru、Rh及びIrからなる群より選ばれた1種又は2種以上の金属であり、特にPdは低温浄化活性とNO_x浄化活性を向上させるものであり好ましい。

【0006】耐熱性酸化物の種類は特に制限されるものではない、例えば、CeO₂、(CeZr)O₂の他、(CeZrY)O₂、(CeZrLa)O₂、(CeZrNd)O₂など、一般式(CeZrLn)O₂(LnはCeを除く希土類金属)で表わされる複合酸化物が好ましい。また、CeO₂よりは(CeZr)O₂の方が高温における浄化活性を高める効果に優れ、更に(CeZrLn)O₂の方が高温における浄化活性を高める効果に優れているので、より好ましい。また、例えば酸化第二セリウムを主体とし、それにAl、Si、Zr、Th及び希土類金属元素よりなる群から選ばれた少なくとも1種類の金属酸化物を含んだもの(特開平6-56322号公報参照)でもよい。

【0007】本発明の製造方法の一態様では、一般式Ln_{1-x}A_xMO₃(LnはCeを除く希土類金属、AはSrを除くアルカリ土類金属又はCe、Mは遷移金属で、いずれも1種又は2種以上、0 < x < 1)で示されるペロブスカイト型複合酸化物に、pHが4以下に調製された貴金属塩水溶液を含浸又は吸着により担持させ、乾燥及び仮焼させた後、耐熱性酸化物とともに水に分散させてスラリーとした後、乾燥及び焼成する。pHを4以下に調製して製造した場合には、ペロブスカイト型複合酸化物は、ペロブスカイト型複合酸化物を核としてその周りを貴金属を固溶したペロブスカイト型複合酸化物が取り囲んだ酸化物となる。貴金属塩水溶液のpHを4以下とする製造方法の場合は、水溶性貴金属塩としてはPdCl₂、PtCl₂、RuCl₃・3H₂Oなどの塩化物、Pd(NO₃)₂、Ru(NO₃)₂、Rh(NO₃)₂などの硝酸塩、Pd(NO₃)₂(NH₃)₂、Pt(NO₃)₂(NH₃)₂などのジニトロジアミン塩など、水溶液が強酸性を示すものが好ましい。

【0008】本発明の製造方法の他の態様では、一般式Ln_{1-x}A_xMO₃(この場合、AはSrを含む)で示されるペロブスカイト型複合酸化物に、pHが10より大きくなるように調製された貴金属塩水溶液を含浸又は吸着により担持させ、乾燥及び仮焼させた後、耐熱性酸化物とともに水に分散させてスラリーとした後、乾燥及び焼成する。貴金属塩水溶液のpHを10より大きくする製造方法の場合は、テトラアミンパラジウムジクロライ

Pd(NH₃)₄Cl₂やテトラアミンパラジウム水酸塩Pd(NH₃)₄(OH)₂などの塩基性水溶液にアンモニア水や酸を添加してpH>10になるように調製して用いるか、PdCl₂、PtCl₂、RuCl₃・3H₂Oなどの塩化物、Pd(NO₃)₂、Ru(NO₃)₂、Rh(NO₃)₂などの硝酸塩、又はPd(NO₃)₂(NH₃)₂、Pt(NO₃)₂(NH₃)₂などのジニトロジアミン塩などの酸性水溶液にアンモニア水を添加してpH>10になるように調製して用いる。

10 【0009】

【発明の効果】本発明の触媒はアイドリング時などの排ガス温度が100~200°C程度の低い条件においてもHC、CO、NO_xに対して優れた浄化活性を示す。また、耐熱性酸化物を含んで900°C以上の高温でも使用できるとともに、NO_xの浄化に有効な貴金属が耐熱性酸化物上よりもペロブスカイト型複合酸化物上に高濃度に存在していることにより耐久性のある触媒となる。

【0010】

【実施例】

【実施例1】

手順A：ペロブスカイト型複合酸化物結晶粉末の製造方法

ペロブスカイト型複合酸化物(La_{1-x}Ce_x)₂(Co_{1-x}Fe_x)O₃粉末の調製方法を説明する。硝酸ランタン103.9g、硝酸セリウム26.1g、硝酸コバルト34.9g、硝酸鉄72.7gを純水に溶解した水溶液0.3リットルを用意した。次に、中和共沈剤として炭酸ナトリウム50gを溶解した水溶液0.5リットルを用意した。中和共沈剤を先の水溶液に滴下し、共沈物を得た。その共沈物を十分水洗し、過濾した後、真空乾燥した。これを600°Cで3時間大気中で焼成後、粉碎し、その後、800°Cで3時間大気中で焼成を行ない、さらに粉碎し、(La_{1-x}Ce_x)₂(Co_{1-x}Fe_x)O₃の粉末を作製した。

手順B：耐熱性酸化物の製造
助触媒として用いる耐熱性酸化物は市販の高比表面積の酸化セリウム粉末(CeO₂、比表面積170m²/g、純度99.9% / TREO(全希土類酸化物) 111.9gを用意し、これにオキシ硝酸ジルコニア(ZrO₂(NO₃)₂)水溶液(液比重1.51、液中にZrO₂換算で25.0重量%含まれる)147.9g、及び硝酸イットリウム(Y(NO₃)₃)水溶液(液比重1.62、液中にY₂O₃換算で21.7重量%含まれる)26.0gを加え、よく攪拌して混合しながら110°Cで10時間大気中で乾燥した。その後、大気中で600°Cで3時間焼成を行ない、(Ce_{1-x}Zr_xY_{2-x}O₃)O₃複合酸化物を約150g得た。

【0012】

手順C：ペロブスカイト粉末へのPdの含有
Pd分で1.1重量部となるように硝酸パラジウム溶液

(Pd濃度4.4wt%) 25重量部と純水50重量部とを混合し、液のpHを1.8に調整した。手順Aで製造した(La_{0.8}Ce_{0.2})(Co_{0.4}Fe_{0.6})O₂ペロブスカイト型複合酸化物粉末98.9重量部に純水20重量部を加えて十分攪拌した後、pH1.8に調整した上記のPd塩水溶液75重量部を含浸させて十分攪拌し、40°Cで30分間保持した。その後、攪拌を続けながら120°Cで12時間乾燥し、空気中にて600°Cで3時間焼成した後、めのう乳鉢にて粉碎し、180μmのメッシュを通過させた。ペロブスカイト粉末98.9重量部に對して添加したPdは金屬分で1.1重量部に相当する。

【0013】手順D：スラリーコート（担持）

手順Aで得たPd含有ペロブスカイト粉末を50重量部、手順Bで製造した耐熱性酸化物粉末を50重量部、セリアゾル（固形分10wt%）を50重量部（固形分では5重量部）、及びジルコニアゾル（固形分30wt%）を3.3重量部（固形分では1重量部）に、全固形分が50wt%となるように純水を58.7重量部を加え、ポールミルにて12時間粉碎しながら混合してスラリーを得た。そのスラリーをコーヘライトハニカムに流入させた後、余剰のスラリーを空気流で吹き払い、均一にコーティングした。スラリーコート後のハニカムを120°Cで12時間乾燥し、空気中にて600°Cで3時間焼成してハニカム状サンプルを得た。

【0014】手順E：Pdの再添加

さらに、手順Cで用いたものと同じ硝酸パラジウム溶液（Pd濃度4.4wt%）12.5重量部を純水50重量部と混合し、液のpHを1.8に調整した。この溶液全量にハニカム状サンプルを浸漬し、40°Cで2時間保持してPdを吸着させた後、120°Cで12時間乾燥させた後、空気中にて600°Cで3時間焼成して実施例1の触媒試料を得た。

【0015】この触媒試料のEPMA（電子線マイクロアナライザー）による分析結果を図1の写真に示す。写真で、画像は走査型電子顕微鏡（SEM）による像であり、黒い大きな粒子はペロブスカイト型複合酸化物で、大きさは約10μmである。白い小さな粒子は耐熱性酸化物粒子で、大きさは約3μmである。中央を横方向に横切るラインは線分析を行なった位置を示す基準ラインであり、波形は分析線上でのPd濃度を表わしている。この写真の結果によれば、ペロブスカイト型複合酸化物粒子の外周部のPd濃度が他に比べて高くなっている。

【0016】（実施例2）実施例1の手順Eで用いた硝酸パラジウム溶液をテトラアンミンパラジウム硝酸塩（Pd濃度4.6wt%）に変え、アンモニア水50重

量部を加えてpHを13.0とした以外は、実施例1と同様に操作により実施例2の触媒試料を得た。

【0017】（実施例3）実施例1の手順Cで用いた硝酸パラジウム溶液をテトラアンミンパラジウム硝酸塩（Pd濃度4.6wt%）に変えた他は、実施例1の手順A～Cと同様の操作にて、ペロブスカイト型複合酸化物粉末98.9重量部に対してPdを金屬分で1.1重量部に相当する量を添加した粉末を得た。その後、実施例1と同様の操作により、実施例3の触媒試料を得た。

【0018】（実施例4）実施例1の手順Cで用いた硝酸パラジウム溶液及び手順Eで用いた硝酸パラジウム溶液を、ともにテトラアンミンパラジウム硝酸塩（Pd濃度4.6wt%）に変え、他は実施例1と同様にして実施例4の触媒試料を得た。

【0019】（実施例5）実施例1の手順Cにおいて、硝酸パラジウム溶液をPd分で2.2重量部となるように50重量部を計量し、手順Eを省いた以外は実施例1と同様の操作により、実施例5の触媒試料を得た。

【0020】（実施例6）実施例1の手順Cにおいて、硝酸パラジウム溶液をテトラアンミンパラジウム硝酸塩（Pd濃度4.8wt%）に代え、Pd分で2.2重量部となるように47.8重量部を計量し、アンモニア水50重量部を加えてpH=13.0とし、手順Eを省いた以外は、実施例1と同様の操作により実施例6の触媒試料を得た。

【0021】（実施例7）実施例4で用いたペロブスカイト型複合酸化物（La_{0.8}Ce_{0.2}）（Co_{0.4}Fe_{0.6}）O₂粉末を（La_{0.8}Sr_{0.2}）（Co_{0.4}Fe_{0.6}）O₂粉末に代え、他は実施例4と同様の操作により実施例7の触媒試料を得た。

【0022】（実施例8）実施例6で用いたペロブスカイト型複合酸化物（La_{0.8}Ce_{0.2}）（Co_{0.4}Fe_{0.6}）O₂粉末を（La_{0.8}Sr_{0.2}）（Co_{0.4}Fe_{0.6}）O₂粉末に代え、他は実施例6と同様の操作により実施例8の触媒試料を得た。

【0023】（実施例9）実施例5で用いたペロブスカイト型複合酸化物（La_{0.8}Ce_{0.2}）（Co_{0.4}Fe_{0.6}）O₂粉末をLa_{0.8}Ce_{0.2}Co_{0.4}O₂粉末に代え、他は実施例5と同様の操作により実施例9の触媒試料を得た。

【0024】（比較例）既に実用化されている自動車用触媒であるPt-Rh/A₁O₃触媒を比較例の触媒試料とした。Pt-Rh含有量は0.43重量部であった。実施例及び比較例の組成を表1に示し、それぞれの触媒活性の測定結果を表2に示す。

【0025】

【表1】

	ペロブスカイト型複合酸化物	Pd含有量 (手順C)	溶液pH (手順C)	耐熱性酸化物	溶液pH (手順E)	溶液pH (手順E)	
実施例1	(La _{0.8} Ce _{0.2})(Ce _{0.4} Fe _{0.6})O ₃ [50]	[0.55]	1.8	(Ce _{0.65} Zr _{0.30} Y _{0.05})O ₂ [50]	1.8	Pd[1.1]	
実施例2	(La _{0.8} Ce _{0.2})(Ce _{0.4} Fe _{0.6})O ₃ [50]	[0.55]	1.8	(Ce _{0.65} Zr _{0.30} Y _{0.05})O ₂ [50]	13.0	Pd[1.1]	
実施例3	(La _{0.8} Ce _{0.2})(Ce _{0.4} Fe _{0.6})O ₃ [50]	[0.55]	13.0	(Ce _{0.65} Zr _{0.30} Y _{0.05})O ₂ [50]	1.8	Pd[1.1]	
実施例4	(La _{0.8} Ce _{0.2})(Ce _{0.4} Fe _{0.6})O ₃ [50]	[0.55]	13.0	(Ce _{0.65} Zr _{0.30} Y _{0.05})O ₂ [50]	13.0	Pd[1.1]	
実施例5	(La _{0.8} Ce _{0.2})(Ce _{0.4} Fe _{0.6})O ₃ [50]	[1.1]	1.8	(Ce _{0.65} Zr _{0.30} Y _{0.05})O ₂ [50]	—	Pd[1.1]	
実施例6	(La _{0.8} Ce _{0.2})(Ce _{0.4} Fe _{0.6})O ₃ [50]	[1.1]	13.0	(Ce _{0.65} Zr _{0.30} Y _{0.05})O ₂ [50]	—	Pd[1.1]	
実施例7	(La _{0.8} Si _{0.2})(Ce _{0.4} Fe _{0.6})O ₃ [50]	[0.55]	13.0	(Ce _{0.65} Zr _{0.30} Y _{0.05})O ₂ [50]	13.0	Pd[1.1]	
実施例8	(La _{0.8} Si _{0.2})(Ce _{0.4} Fe _{0.6})O ₃ [50]	[1.1]	13.0	(Ce _{0.65} Zr _{0.30} Y _{0.05})O ₂ [50]	—	Pd[1.1]	
実施例9	(La _{0.8} Ce _{0.2})CoO ₃	[50]	[1.1]	1.8	(Ce _{0.65} Zr _{0.30} Y _{0.05})O ₂ [50]	—	Pd[1.1]
比較例					γ-Al ₂ O ₃ [100]	1.8	Pt-Rh[0.43]

〔 〕内の数値は重量部を表わす。

	初期 50% 净化温度 (°C)			耐久後 50% 净化温度 (°C)		
	CO	HC	NO	CO	HC	NO
実施例 1	138	156	155	231	236	220
実施例 2	131	151	151	220	226	218
実施例 3	150	167	169	232	237	223
実施例 4	141	164	170	226	233	218
実施例 5	138	162	152	212	224	214
実施例 6	132	166	168	231	240	216
実施例 7	134	155	148	218	231	225
実施例 8	130	160	155	227	241	234
実施例 9	129	154	137	236	246	248
比較例	193	208	198	263	276	259

【0027】触媒活性の測定と耐久試験は以下のように
行なった。

触媒活性の測定

ハニカム状(セル数 400/inch³) コージェライト担
体(直径 30 mm、長さ 50 mm)に担持されたそれぞ

れの試料を下記のモデルガスにて活性を測定した。ガス

温度は触媒への入口ガス温度で示し、室温から昇温し、*40

* NO、CO、HC (C₃H₈+C₂H₂) のそれぞれが初期
濃度の 50% に低下した温度を 50% 净化温度とする。

また、リッヂガスとリーンガスはそれぞれ 1 秒毎に切り
換えた。触媒を通るガス流の空間速度 (SV) は 30,
000 / 時間とした。

【0028】

	リッヂガス	リーンガス
CO	2.6 %	0.7 %
HC (C ₃ , 换算濃度)	0.19%	0.19%
H ₂	0.87%	0.23%
CO ₂	8 %	8 %
NO	0.17%	0.17%
O ₂	0.65%	1.8 %
H ₂ O	10 %	10 %
N ₂	残部	残部

【0029】耐久試験

50 上記のリッヂガスとリーンガスを 5 秒毎に切り換えて 9

11

00°Cで30分、750°Cで30分のサイクルを15回
繰り返して耐久試験を行なった。耐久試験後にも前記の
方法で触媒活性を測定した。表2の結果から明らかなよ
うに、各実施例では初期においても耐久後においても5*

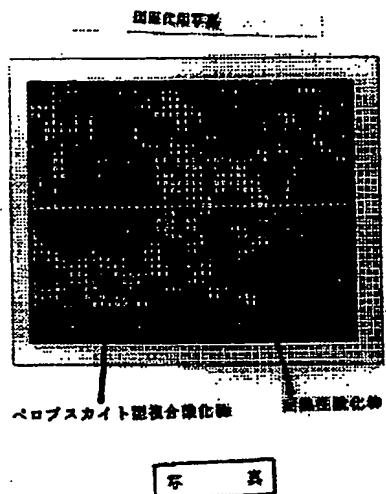
* 0%浄化温度が低く、比較例では高い。

【図面の簡単な説明】

12

【図1】実施例の触媒の金属組成とパラジウム分布を示
す顕微鏡写真である。

【図1】



フロントページの続き

(72)発明者 高橋 一郎

滋賀県蒲生郡竜王町大字山之上3000番地
ダイハツ工業株式会社滋賀テクニカルセン
ター内

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- BLACK BORDERS**
- IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- FADED TEXT OR DRAWING**
- BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- SKEWED/SLANTED IMAGES**
- COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- GRAY SCALE DOCUMENTS**
- LINES OR MARKS ON ORIGINAL DOCUMENT**
- REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- OTHER:** _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.